THEATER SOUND SYSTEM BASICS

How to get excellent sound in your play or musical

by Bruce Bartlett (c) 2013

Quality microphones are only one factor in getting great sound in your productions. The rest of the equipment is important, too. Here's a step-by-step procedure on how to choose and set up the mics, mixer/amplifier, and speakers to make the actors' voices easy to understand.

A sound system to amplify actors has five main pieces of equipment:

- microphones
- a mixer
- a power amplifier
- loudspeakers
- cables

Microphones pick up the actors' voices. Floor mics sit on the stage floor near the front edge. Our floor-mic models are the **Stage Floor Mic** and **Stage Floor Mic C.**

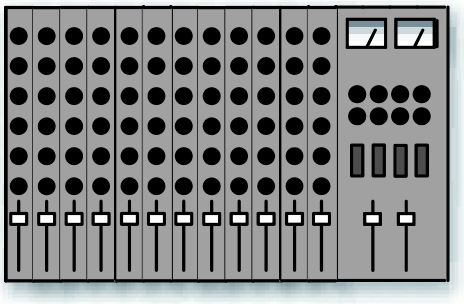
Mic cables carry the signal from the mics to the mixer. The type of mic cables you need are called "2-conductor shielded mic cables" with a male XLR connector on one end, and a female XLR connector on the other end. They typically come in 15 or 20 foot lengths, and you can connect several of them together to reach from the stage to your mixer.

Mic cable

Rather than running several mic cables from the stage to the mixer, you might prefer to use a **Mic Snake** (below) It's a metal box with several mic connectors in it, wired to a long, thick cable (maybe 50 or 100 feet long). At the end of the cable are several XLR connectors which plug into your mixer. Using a snake is easier and neater than using many separate mic cables. You still may need some 20-foot mic cables to reach from the stage to the snake box.

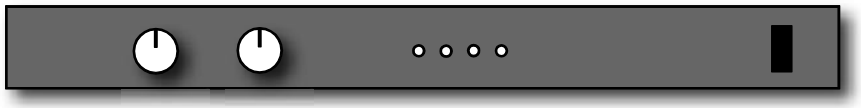
Mic snake

A **mixer** amplifies the mic signals and lets you control their volume and tone (bass, midrange and treble). It also mixes in music and sound effects from an mp3 player or computer. The mixer combines the signals of all the mics and your music player into one signal at the mixer output.

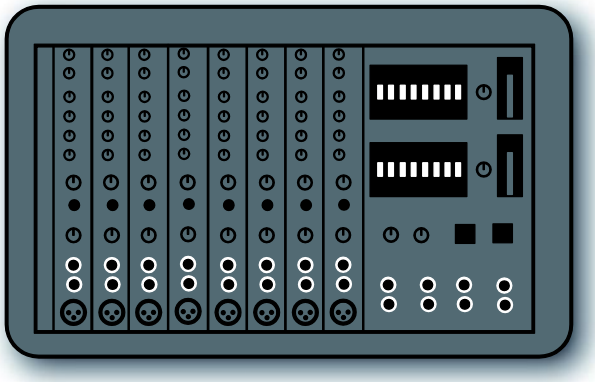


Mixer

A **power amplifier** makes the signal louder. It further amplifies the mixer signal up to a stronger level that can drive loudspeakers. Note: A **powered mixer** combines a mixer and power amp in a common chassis.



Power amplifier



Powered mixer

If your sound system has a separate mixer and power amplifier, you need a **cable between the mixer and power amplifier.** On one end of this cable is a connector that mates with your mixer output connector. The cable connector might be an XLR connector, phone plug or RCA plug. On the other end of the cable is a similar connector that mates with your power amplifier input connector. You won't need this cable with a powered mixer.

Cable with phone plugs

Cable with XLR connectors

Cable with RCA plugs

Loudspeakers play the amplified actors' voices to the audience. A typical PA speaker has an 8" to 15" woofer cone and a horn-shaped tweeter, as shown below.

A typical portable PA loudspeaker

In some sound systems, the power amplifier is built into a loudspeaker. That's called a **powered speaker** or **active speaker**. Using an audio cable, you connect the mixer output to the powered speaker input.

The best type of speaker to use in a gymnasium might be a column speaker or line array speaker (shown below). It focuses sound on the audience rather than radiating it around the room. That prevents a muddy sound and makes speech easier to understand. Two of those on speaker stands can work really well to provide clear sound, even in a gym.

The Bogen SCW35 is an example of a column speaker. It has six vertically-arrayed 6" speakers in a single cabinet.

A column speaker

Speaker cables go between the power amplifier and the speakers. Speaker cable comes in a few forms. The simplest is zip cord or lamp cord, which is the kind of wire connected to a lamp. It's two strands of wire coated in rubber or plastic. Another type of speaker cable has the two wires encased in a rubber or plastic cylinder.

Speaker cable made of zip cord or lamp cord

On either end of the speaker cable is a connector that mates with your amplifier on one end, and your speakers on the other end. Typical connectors are 1/4" phone plugs, banana plugs, and Speakon™ connectors (left to right below).

Speaker cable with phone plugs

Speaker cable with banana plugs

Speaker cable with Speakon™ connectors

Shown below are various connectors used on speaker cables:

Banana plug:

Phone plug:

Speakon™ connector on back of power amplifier:

Speakon™ connector on cable:

A **speaker stand** is a collapsible stand that mounts a loudspeaker 6 to 14 feet high off the floor. That way, the speakers don't blast the nearest listeners, and the sound clears the heads of the audience and isn't blocked by them. Some people omit the speaker stand, and hang the speakers on the side walls instead.

Speaker stand holding up a loudspeaker

Setup procedure

1. Choose a microphone. Our **Stage Floor Mic** has a 15-foot detachable cable, and the **Stage Floor Mic C** has a 6-foot permanent cable for extra ruggedness. I suggest that you use the Stage Floor Mic unless the mics are likely to be stepped on.

Stage Floor Mic

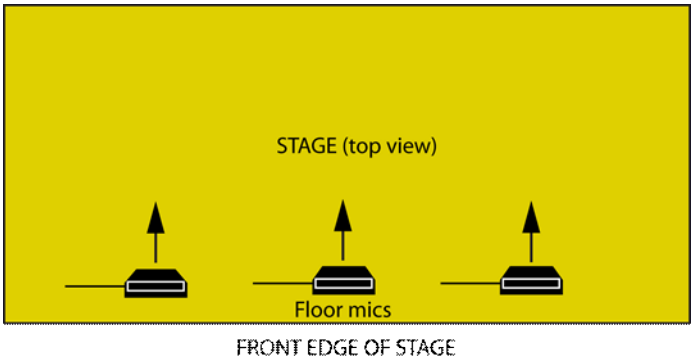
Stage Floor Mic-C

2. Decide how many stage-floor mics you need:

20 ft stage: 1 mic center stage.
24-30 ft stage: 2 mics 12 to 15 feet apart.
35-40 ft stage: 3 mics 15 feet apart.
45-50 ft stage: 3 mics 17 feet apart.

If you can stage all the talking parts center stage, you need only one floor microphone in the center of the stage near the footlights.

3. Put the mics on stage with each mic cable exiting to the left, about 1 foot in from the stage edge.



Connect each microphone to a long mic cable -- long enough to reach from the stage to your mixer. Radio Shack is one seller of mic cables. Your school or church might already have mic cables. You can connect several cables end-to-end to make a long cable run. Or you can use a **mic snake**, which is a metal box with several mic connectors and a long, thick cable going to the mixer.

4. Plug the mic cables into a mixer that has **phantom power** (which is power that a mixer sends to a microphone on its mic cable.) If your mixer lacks phantom power, purchase a **phantom power supply** -- one per microphone. It is available online or in music stores for about $20 to $40. Plug each mic into a phantom power supply input. Using a mic cable, connect the output of each phantom power supply into your mixer mic inputs.

Two phantom power supplies

5. Figure out how long a speaker cable you will need. If the speaker is 50 feet from the mixer/amplifier, you need at least 50 feet of speaker cable. If you have two speakers, you need twice as much speaker cable.

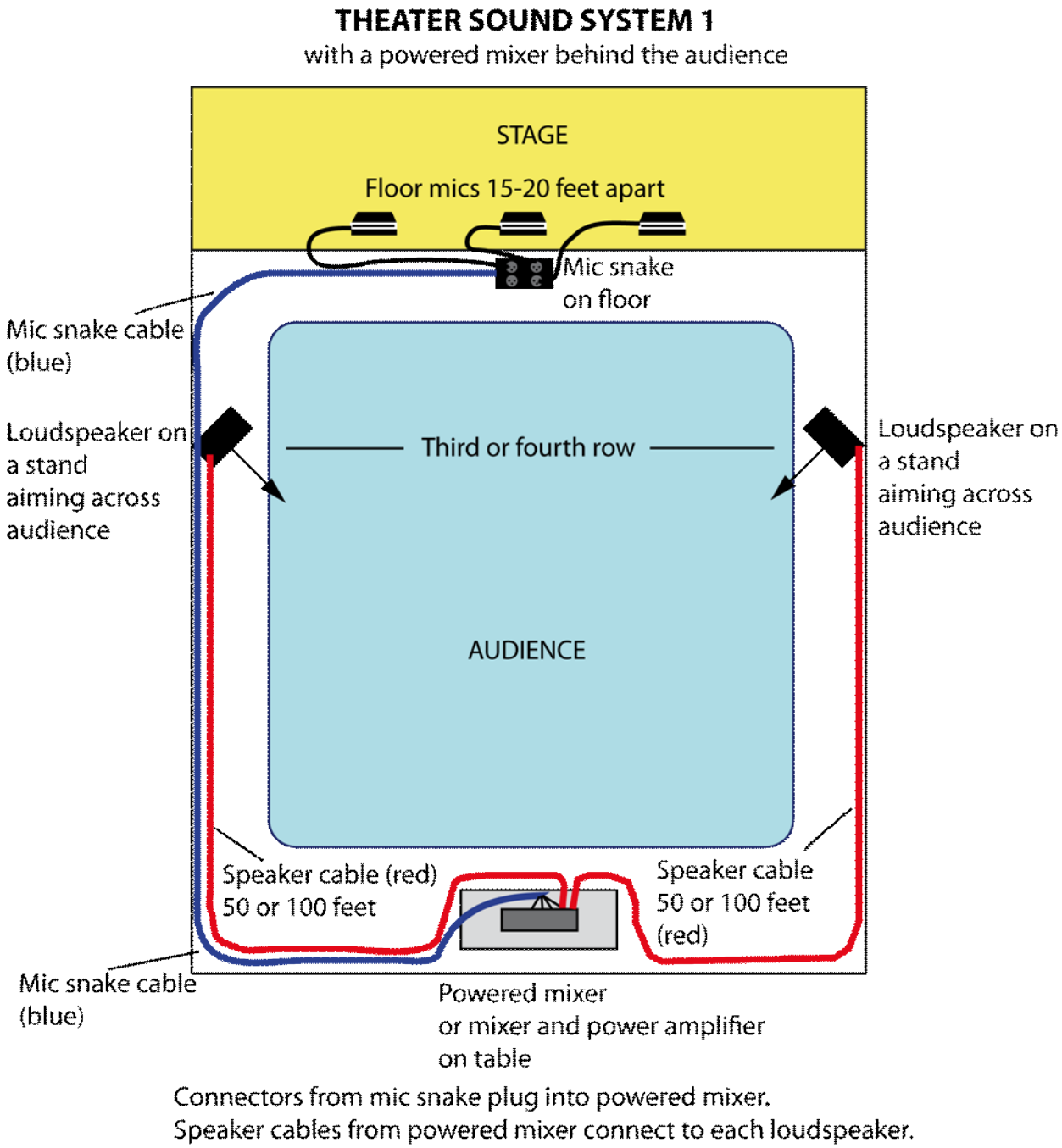
6. Using those speaker cables, connect the power amplifier outputs to the loudspeakers, which are mounted on stands or hung on the wall.

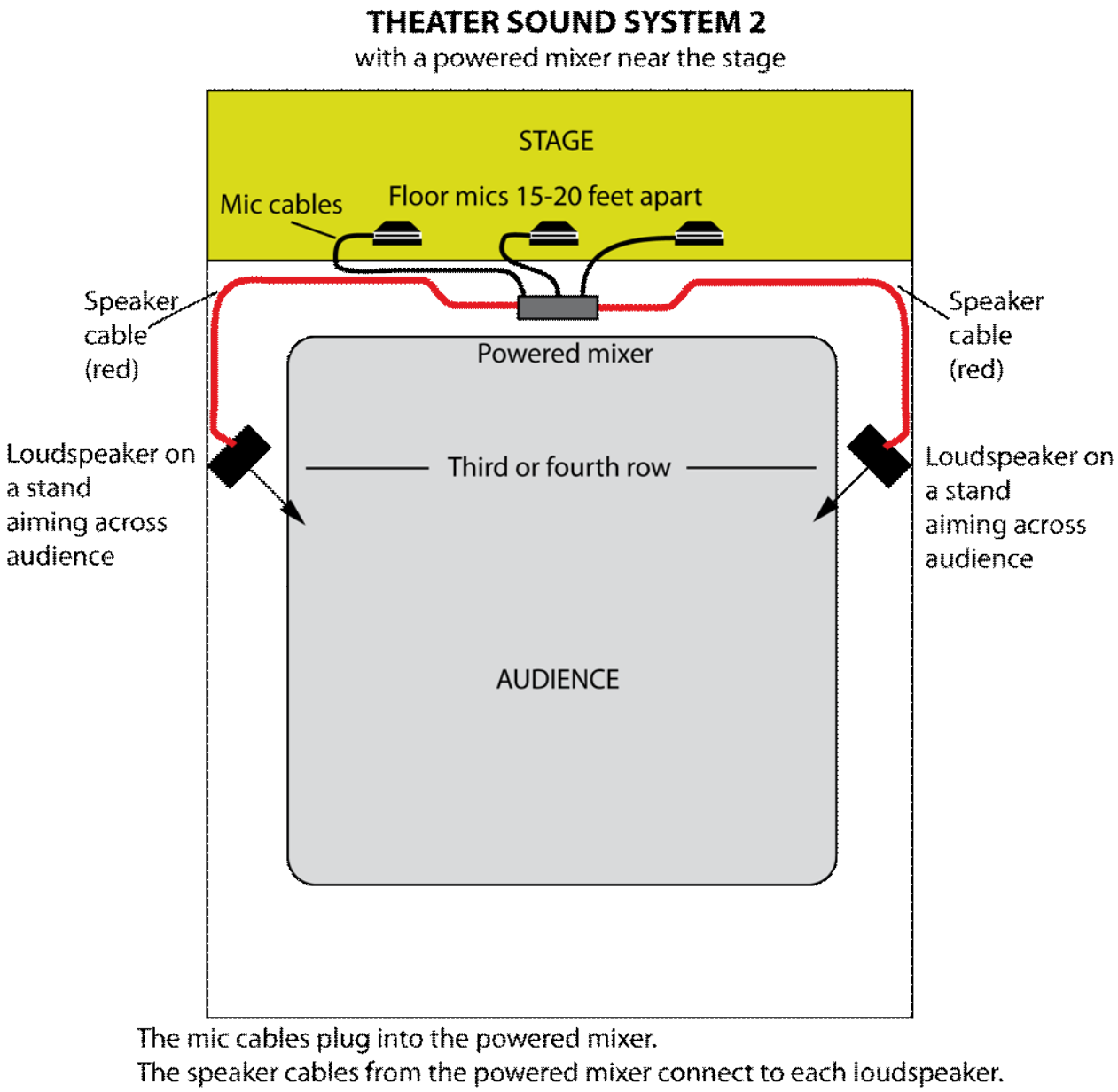
System layout

Show on the next two pages are two theater sound systems. In **System 1**, the powered mixer is behind the audience. The advantage is that the sound person can hear what the audience is hearing. In **System 2,** the powered mixer is near

the stage. The advantage is that all the cables can be shorter. If you use System 2, have someone in the audience listen to make sure the sound is okay.

The speakers must be closer to the audience than to the mics. For example, if the speakers are 10 feet from the microphones, but 20 feet from the audience, the sound system will not work well -- you'll get a lot of feedback when you turn up the mics loud enough to hear them.




THEATER SOUND SYSTEM 2
with a powered mixer near the stage
STAGE
Mic cables
Floor mics 15-20 feet apart
Speaker cable (red)
Speaker cable (red)
Powered mixer
Loudspeaker on a stand aiming across audience
Third or fourth row
Loudspeaker on a stand aiming across audience
AUDIENCE
The mic cables plug into the powered mixer.
The speaker cables from the powered mixer connect to each loudspeaker.

Using the mixer

1. Start with all the equipment turned off. If you have a separate power amplifier and mixer, set the power amplifier's volume controls halfway up.

2. Using a strip of masking tape, labels the faders according to the mic or sound-effects player that each fader affects.

3. Turn down all the mixer faders (sliding volume controls).

4. On the mixer, set all the **EQ** or **equalization** knobs and **pan** knobs to "flat" (straight up, or 12 o'clock). Turn down all the **AUX** knobs (full counterclockwise).

5. Each mic channel in the mixer might have ASSIGN buttons. If so, assign all the mics to Group 1. Assign the Group 1 output to the main mix, and turn up the Group 1 fader to "0" (about 3/4 up).

6. Turn on the mixer.

7. On the mixer, turn on phantom power if necessary. There should be a button on the mixer labeled "Phantom", "P48", or "48V". Then turn on the power amplifier.

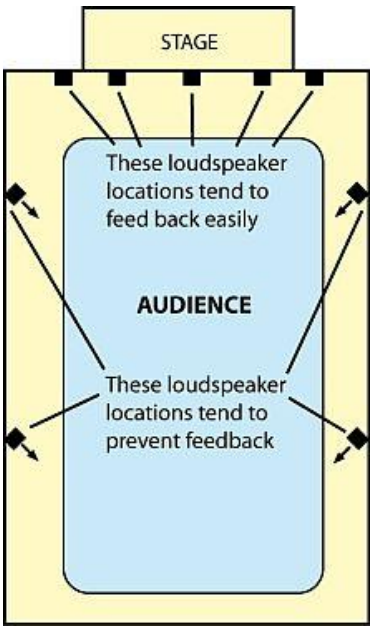
8. On the mixer, turn up the master faders to "0" (about 3/4 up).

9. Have someone talk loudly on stage about 10 feet in front of a microphone. On the mixer, turn up the **GAIN** knob for that mic until that mic's **CLIP** or **OVERLOAD** light flashes, then turn down the knob just until the flashing light stays out. Repeat for each microphone. This procedure prevents noise and distortion.

10. Slowly turn up the fader for the microphone nearest the actor speaking. The sound over the PA system should get louder. If you turn up the volume enough, you'll hear feedback (a squealing tone). Turn down the fader to the point where feedback stops, and don't exceed that point during a show. Mark that point with a grease pencil. If the sound is too quiet in general, turn up the volume controls on the power amp, but watch out for feedback.

10 Tips to Reduce Feedback

1. Speaker placement near the stage can cause feedback. So place the speakers close to the audience as shown below, near the side walls of your theater, about the 3rd row back, and aiming diagonally across the audience. Use one loudspeaker on each side of the audience as shown below:


STAGE
These loudspeaker locations tend to feed back easily
AUDIENCE
These loudspeaker locations tend to prevent feedback

Bird's-eye view of a theater. Speaker placement affects feedback.

If your existing loudspeakers are permanently installed, you might want to buy, borrow or rent two portable PA speakers on speaker stands. You'll also need long speaker cables.

2. Have a sound person turn the mic faders up or down on the mixer to follow the action on stage. Ideally only one mic is on at a time. The more mics that are turned up, the more feedback.

3. Place the mics as close to the actors as possible without getting in their way.

4. Train the actors to project their voices loudly toward the audience. The microphones need something to pick up.

5. Do not cover the grille holes with tape. That can cause feedback and change the sound of the mic.

6. If you can't hear sibilance ("s" sounds) clearly, turn up the high-frequency EQ a little at 10 kHz, but watch out for

feedback.

7. Do not use compression. It softens loud sounds, and you might need that extra volume.

8. Optional: If feedback is a serious problem, use a feedback suppressor. That can increase the volume by 6 to 9 dB, which is a lot. Plug the feedback suppressor into the Group 1 insert jack. (Group 1 is the group of microphone signals that you created earlier). Another option is to connect the feedback suppressor between the mixer and power amplifier.

Here's the Sabine feedback suppressor, model FBX-SOLO SM-820 ($314):

http://www.sabine.com/Pro_FBX_Solo_index.htm

Here's the Behringer feedback destroyer, model FBQ1000 ($150):

http://www.behringer.com/EN/Products/FBQ1000.aspx

Instead of a feedback suppressor, you could use a 1/3-octave graphic equalizer between the mixer and the power amplifier, or plugged into the mic group's **insert** jacks in the mixer. Turn down frequencies that feed back just to the point where ringing stops.

9. The audience will hear the sound coming out of the loudspeakers instead of from the stage. As an option, you might want to delay the signal going to the speakers so that the audience will localize the sound on stage. The Behringer Shark DSP110 is a low-cost audio delay unit.

10. If the stage is carpeted, put each mic on a hard foot-square panel of 1/8" masonite or something similar. That prevents muffled sound.

If you want to know more about audio systems, equipment and techniques, check out more audio articles on the Bartlett Audio website.